If you are using a printed copy of this procedure, and not the on-screen version, then you MUST make sure the dates at the bottom of the printed copy and the on-screen version match. The on-screen version of the Collider-Accelerator Department Procedure is the Official Version. Hard copies of all signed, official, C-A Operating Procedures are available by contacting the ESSHQ Procedures Coordinator, Bldg. 911A

C-A OPERATIONS PROCEDURES MANUAL

7.1.52 RHIC Warm-Up / Transition to 80K Cooler

Text Pages 2 through 7

Hand Processed Changes

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Collider-Accelerator Department Chairman Date

D. Lederle

7.1.52 RHIC Warm-Up / Transition to 80K Cooler

1. Purpose

This procedure provides instructions for the warm-up of the RHIC rings and refrigerator.

2. Responsibilities

2.1 The Shift Supervisor, or an Operator designated by the Shift Supervisor, is responsible for conducting the procedure and providing documentation in the Cryogenic Control Room Log.

2.2 Should a problem arise during the completion of this procedure, the Shift Supervisor shall contact the Technical Supervisor for instructions before continuing.

3. Overview

3.1 The blue ring will be kept cold as yellow is warmed up. The yellow ring JT valves will be shut. The M and S lines will be made common. As the ring warms, cold gas will be forced back through the supply line and will be used to liquefy at the LSA. Ring pressure control H206A, H100A, H74A will be at their normal setpoints initially, then may need to be set to the match the pressure of the VJRR S line to maintain some flow through FE210. This will keep the blue ring cold. This will continue until the ring gas can no longer be used to liquefy, at which time the ring gas will be routed back to compressor return through the appropriate CR bypass, or the thermax heaters. Liquid production will continue via refrigerator and by repeating the process for the blue ring.

4. Prerequisites

4.1 Reduce helium inventory as shutdown nears. Leave 1 – 4 tanks on at 8 atm with the rest at 1.3 atm, at least two liquid helium dewars at low levels and cold.
4.2 Thermax heater and refrigerator cold end calorimeter should be available.
4.3 Align at least 25 warm gas tanks for pump back.

5. Precautions

5.1 This procedure provides general guidelines for the RHIC warm-up. The steps in this procedure may vary depending on the operational requirements at the time of warm-up, i.e. schedule, testing, equipment problems, etc.

6. RHIC Warm-up Procedure

Yellow Ring

1. Commence making liquid into LSA using normal methods.

2. Set cold end calorimeter between 0 and 2 kW initially and adjust flow through H173A to balance refrigerator.

3. Close all yellow ring JT valves (page D285).

4. Make M and S lines common. At 6:00 yellow valve box, check open H6730A, and H6607A. Slowly force open H6601A. Open H6701A and H6705M. Allow M and S lines to equalize.

5. Leave lead flows as is initially.

6. Set H1100A to manual and closed.

7. Ring will begin to warm up, forcing cold gas back through supply line, increasing pressure in supply line. H100A may begin to close. Adjust H100A and H206A setpoints as necessary to maintain some flow through Fe210. Increase calorimeter power, and flow through H173A as necessary to balance the refrigerator.

8. Liquid production into LSA will continue with most of the gas being supplied from the warming ring, and very little being supplied from the refrigerator. JT flow rate should be approximately 200 g/s.

9. Increase the rate of liquid production as necessary to control supply line pressure at approximately 3.5 atm.

10. If necessary, vent excess gas to CR line by opening H6737A and throttling open H6706A. Monitor compressor inlet temperature and use thermax heaters if necessary.

11. Precool the R-line from the LSA to accept boil off from LSA. Verify R-line pressure is higher than CR pressure, then precool by flowing backward through H4505A, H9704A and H4525A to CR line.

12. Continue liquid production as long as possible based on supply pressure and temperature at the LSA. Use heat shield supply to warm up the M-line and return more gas to the S-line. At 6 YVB, close H6701A, H6601A, H6700A. Open H6716A and intermittently crack open H6715A. Monitor S-line pressure. Open JT valve H6605A to help cool the gas from the ring. Monitor refrigerator R-line temperature.

13. Monitor FE210 flow, and make up valve H3031A position, to ensure that most of the cold helium supply to the LSA is coming from the warming ring and not the tank farm/refrigerator. Adjust JT valve flow rate, and/or adjust H100A and H206A setpoint as necessary.

14. If conditions are stable with liquefaction into the LSA at < 100 g/s from the yellow ring, start the blue ring procedure (step 19 below) and work in parallel with the remaining steps of this yellow procedure.

15. When the ring temperature/pressure can no longer be used to produce liquid at the LSA, or the Blue ring cannot be maintained, isolate the yellow ring M-line from the supply line. Close H6607A, H6601A, H6701A. Verify H6605A shut. Send the gas from the yellow ring back to compressor return through the appropriate bypass. (6Y)Open H6737A, use H6706A to control pressure in ring at approximately 3 atmospheres. Or use alternate controller to control downstream pressure PI4844 at approximately 2 atm. Stop venting ring and close all M-line valves when the average ring pressure divided by the average ring temperature is .1 to .15.

16. Continue liquid production at the LSA via the refrigerator and tank farm.

17. Put power lead flow controllers to manual and 0. Shut off level probe power.

18. Offload liquid helium

Blue Ring

Prerequisites:

a. Yellow ring pressure stable.
b. The equivalent of at least two Dewars available at the LSA.
c. At least 6 tanks available at the tank farm.

19. Close all blue ring JT valves (page D285).

20. Make M and S lines common. At blue valve box, check open H4630A and H4524A. Slowly force open H4501A. Open H4601A, and H4614M. Allow pressures to equalize.

21. Leave lead flows as is initially.

22. Ring will begin to warm up, forcing cold gas back through supply line, increasing pressure in supply line. H100A may begin to close. Adjust H100A and H206A setpoints as necessary to maintain some flow through FE210.

23. Calorimeter will be needed at this point. Set it to .5 to 3 Kw initially and adjust to balance refrigerator.

24. Liquid production into LSA will continue with most of the gas being supplied from the warming ring, and very little being supplied from the refrigerator.

25. Increase the rate of liquid production as necessary to control supply line pressure.

26. If necessary, vent excess gas to CR line by opening H4637A and throttling open H4606A. Monitor compressor inlet temperature and use thermax heaters if necessary.

27. Continue liquid production as long as possible based on supply pressure and temperature at the LSA. Use heat shield supply to warm up the M-line and return more gas to the S-line. At 6 YVB, Close H4601A, H4501A, H4600A. Open H4616A and intermittently crack open H4615A. Monitor S-line pressure. Open JT valve H4558A to help cool the gas from the ring. Monitor refrigerator R-line temperature.

28. Monitor FE210 flow, and make up valve H3031A position, to ensure that most of the cold helium supply to the LSA is coming from the warming ring and not the tank farm/refrigerator. Adjust JT valve flow rate, and/or adjust H100A and H206A pressure setpoints as necessary.

29. When the ring temperature/pressure can no longer be used to produce liquid at the LSA, isolate the ring from the supply line. Close H4524A, H4601A, H4501A. Verify H4558A shut.

30. Continue liquid production at the LSA via the refrigerator and tank farm.

31. Send the gas from the blue ring back to compressor return through the appropriate bypass. At 6:00 blue, open H4637A, use H4606A to control pressure in ring at approximately 3 atmospheres; or use alternate controller to control downstream pressure PI4844 at approximately 2 atm. Stop venting ring and close all M-line valves when the average ring pressure divided by the average ring temperature is .1 to .15.

32. When conditions are stable, close all lead flows in the both rings from the computer, including valve box leads (close all tunnel and valve box WR valves). Close all thermistor valves and valve box power lead isolation valves as soon as practical.

33. When liquid production at the LSA is complete, isolate heat shields: Close H25A. After heat shields have bled down to 9 atm, slowly close H376M/H776M. Bleed heat shield pressure down to approx 5.5 atm through H156M, and the appropriate CR bypass. Close H9A. At 6:00B, close H4616A, H4516A, H4602A, H4645A, H4502A. At 6:00Y, close H6716A, H6616A, H6702A, H6745A, H6602A. When the yellow heat shield is at approximately 90K, and 8 atm, put on the 80 K cooler. When the blue heat shield is at approximately 90K, and 8 atm, put on the 80 K cooler.

34. Maintain 50 – 80 g/s flow through the thermax.

35. Isolate R-lines at 6:00 when temperatures get too warm for the refrigerator R-line.

36. Put power lead flow controllers to manual and 0. Shut off level probe power

37. Off load liquid helium

7. Refrigerator Warm-up Procedure

Prerequisites

1. Helium Off loaded. Minimal cold gas coming off the rings.

2. At least 15 warm gas tanks are at about 1 atm available for pump back.

Procedure

1. Empty refrigerator liquid Helium pots. Close H100A (manual closed), and disable discharge/pot level controls.

2., Check closed H25A, H9A.

3. Shut off cold end refrigerator calorimeter.

4. Shut off all first stage and second stage compressors except for 1 first stage and one second stage.

5. Align 10 new tanks for pumpback. Stay off of leaking tanks.

6. Shut off turbines.

7. Secure turbine skids. Shut off turbine oil pumps.

8. Ensure the utility and main compressors have pump back and bypass control.

9. Isolate on-line adsorbers, and turbines. These can sit on relief valves until regenerated.

10. Close all turbine filter inlet and outlet valves.

11. Isolate high pressure side of refrigerator. It will be assumed this gas is dirty and will be vented down to just above 1 atm. Close spider valves, H86A, H100A, H74A.

12. Secure the seal gas compressor 30 min after the turbines have been shutdown. Isolate the seal gas reserve tank.

13. Ensure that the ring CR line is separated from the refrigerator CR line: Open/check open H849A, H9935M. Close/check closed H4644A, H5M. Vent any excess pressure in the refrigerator CR line back to normal return through H123A.

14. Shutdown main compressors and set up a scrub flow path to scrub the tank farm using the redundant compressor or a second stage. Open both redundant suction valves. Set H3007A to approx 1.1 atm. Align H3065A as make up through H3010M. Control discharge pressure using pump back valve H3025A. Align flow path through one carbon filter to the purge return header to purifier, then through a second carbon filter. Scrub all tanks until N2 is less than 5ppm to ensure clean make-up gas for 80K cooler operation.

15. Control refrigerator warm-up at approx. 10K per hour by adjusting valve H74A, or H206A and flowing through H1100A and thermax heaters.

16. Warm the LSA dewars by sending warm gas into the dewars and returning through H4505A.

17. Isolate both warm heat exchangers on return side.

8. Documentation

None

9. References

None

10. Attachments

None